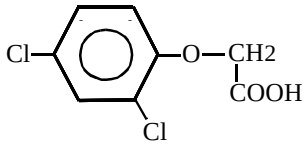
2,4-D, SALTS AND ESTERS
(2,4-DICHLOROPHENOXYACETIC ACID)

2,4-D, salts and esters are federal hazardous air pollutants and were identified as toxic air contaminants in April 1993 under AB 2728.

CAS Registry Number: 94-75-7

Molecular Formula: $C_8H_6Cl_2O_3$



2,4-D (2,4-dichlorophenoxyacetic acid) occurs as a white to yellow crystalline powder with a slight phenolic odor (HSDB, 1991). It is soluble in organic solvents and almost insoluble in water (Merck, 1983). There are different forms available: sodium salt (60 to 80% acid), amine salts (10 to 60% acid), and esters (10 to 45% acid) (Sax, 1987). These forms are dispersible in water or oils (esters).

Physical Properties of 2,4-D; salts and esters

Synonyms: 2,4-dichlorophenoxyacetic acid; Hedonal; Trinoxol; 2,4-D acid

Molecular Weight:	221.04
Boiling Point:	160 °C at 0.4 mm Hg
Melting Point:	138 °C
Density/Specific Gravity:	1.416 at 25/4 °C (water = 1)
Vapor Pressure:	1.05×10^{-2} mm Hg at 25 °C
Log Octanol/Water Partition Coefficient:	2.81
Water Solubility:	682 mg/l at 25 °C
Conversion Factor:	1 ppm = 9.04 mg/m^3

(Howard, 1990; HSDB, 1991; Merck, 1989; U.S. EPA, 1994a)

Examples of 2,4-D Compounds

2,4-D alkanolamine salts	2,4-D butoxyethanol ester	2,4-D butoxypropyl ester
2,4-D diethanolamine salt	2,4-D dimethylamine salt	2,4-D 2-ethylhexyl ester
2,4-D isooctyl ester	2,4-D isopropyl ester	2,4-D propyl ester
2,4-D triethylamine salt	2,4-D triisopropylamine salt	
	2,4-D N-oleyl-1,3 propylenediamine salt	

SOURCES AND EMISSIONS

A. Sources

2,4-D salts and esters are registered as herbicides. They are used for control of annual and perennial grasses and broadleaf weeds in a variety of agricultural, park land, golf course and other ornamental turf related situations. They are also registered for use by homeowners for control of weeds in lawns and in and around gardens, and for the control of poison oak around residences. 2,4-D salts and esters are registered for the control of aquatic weeds, and they are used in silviculture and conservation reserve program areas for the management of deciduous broadleaf shrubs and trees to allow the emergence of coniferous trees (DPR, 1996).

The licensing and regulation of pesticides for sale and use in California is the responsibility of the Department of Pesticide Regulation (DPR). Information presented in this fact sheet regarding the permitted pesticidal uses of 2,4-D has been collected from pesticide labels registered for use in California and from DPR's pesticide databases. This information reflects pesticide use and permitted uses in California as of October 15, 1996. For further information regarding the pesticidal uses of this compound, please contact the Pesticide Registration Branch of DPR (DPR, 1996).

The primary stationary sources that have reported emissions of 2,4-D in California are funeral and crematorium services (ARB, 1997b).

B. Emissions

The total emissions of 2,4-D salts and esters from stationary sources in California are estimated to be at least 670 pounds per year based on data obtained from the Air Toxics "Hot Spots" Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

No information about the natural occurrence of 2,4-D, salts and esters was found in the readily-available literature.

AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of 2,4-D, salts and esters.

INDOOR SOURCES AND CONCENTRATIONS

In the Nonoccupational Pesticide Exposure Study (NOPES), levels of 32 pesticides

were measured in 24-hour samples obtained inside and outside homes located in 2 cities. Approximately 70 homes in Jacksonville, Florida were monitored in each of 3 seasons, and approximately 50 homes in Springfield/Chicopee, Massachusetts were monitored in each of 2 seasons. Mean concentrations of 2,4-D esters ranged from below detection limits to 2.5 nanograms per cubic meter (ng/m^3) in Jacksonville, and from below detection limits to 2.1 ng/m^3 in Springfield/Chicopee. For both cities, average indoor 2,4-D ester concentrations were higher than corresponding outdoor concentrations (Immerman and Schaum, 1990).

ATMOSPHERIC PERSISTENCE

2,4-D has an estimated atmospheric lifetime of less than 1 day. One reaction product that has been identified is 2,4-dichloroanisole (Kao, 1994).

AB 2588 RISK ASSESSMENT INFORMATION

2,4-D emissions are not reported from stationary sources in California under the AB 2588 program. It is also not listed in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program Revised 1992 Risk Assessment Guidelines as having health values (cancer or non-cancer) for use in risk assessments (CAPCOA, 1993).

HEALTH EFFECTS

Probable routes of human exposure to 2,4-D are inhalation, ingestion, and dermal contact.

Non-Cancer: Neurotoxicity is the predominant effect of acute short-term inhalation and oral overexposure to 2,4-D, with symptoms including stiffness of arms and legs, incoordination, lethargy, anorexia, and coma in humans. Dermal contact may result in a rash or dermatitis in humans. Overexposures have rarely produced peripheral neuropathies (U.S. EPA, 1994a).

The United States Environmental Protection Agency (U.S. EPA) has not established a Reference Concentration (RfC) for 2,4-D, but has set an oral Reference Dose (RfD) of 0.01 milligrams per kilogram per day, based on hematologic, hepatic, and renal toxicity in rats. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects (U.S. EPA, 1994a).

There is evidence for adverse reproductive effects in animals, with no information available for such effects in humans (U.S. EPA, 1994a).

Cancer: Several human studies have suggested an association between exposure to 2,4-D (and other herbicides) and an increased incidence of tumor formation. The U.S. EPA has classified 2,4-D as Group D: Not classifiable as to human carcinogenicity, based on lack of human and animal evidence (U.S. EPA, 1994a). The International Agency for Research on

Cancer has classified chlorophenoxy herbicides including 2,4-D as Group 2B: Possible human carcinogen based on limited evidence in humans (IARC, 1987a).